Cytokinins have been found in all complex plants, as well as mosses, fungi, and bacteria. Cytokinins are a group of hormones. These hormones promote cell division in plant roots and shoots, and they promote the growth of buds. Today, there are about 200 different natural and synthetic cytokinins known to botanists.

Most cytokinins are produced in the **meristem** of the roots. Meristem is the name given in botany for the region of tissue within the part of a plant that actively promotes cell division. Once the cytokinin has been produced in the roots, it travels up the xylem, or vascular tissue, to other parts of the plant where continuous growth takes place, such as young leaves, developing fruits, and seeds.

Natural and Synthetic Cytokinins

They are plant growth hormones which are basic in nature, either amino purine or phenyl urea derivatives, that promote cytokinesis (= cell division) either alone or in conjunction with auxin. The first cytokinin was discovered by Miller et al; 1955.

They named this as Kinetin (6-furfuryl amino-purine). Kinetin does not occur naturally in plants. It is a synthetic hormone. The first natural cytokinin was obtained from unripe maize grains by Letham et al. (1964). It is known as Zeatin which is a N^6-substituted adenine found in RNA hydroly- sates from peas, spinach, wheat germ, potato tubers and other plants. The t RNA fraction of RNA is especially rich in zeatin.

Another cytokinin of wide spread occurrence in plants is isopentyladenine (IPA) which is found with the ribosyl derivative isopentyladenosine. IP A had been synthesized by Keonard and Fujii in 1961.

6-benzyladenine is similar in structure to kinetin and is very active in promoting callus growth. The isomeric form, 1-benyzladenine has limited activity. Skoog, Leonard, and associates have synthesized numerous derivatives of adenine and many are active as cytokinins in the growth of tobacco stem pith callus and other callus tissues.

Benzimadazole and adenine both have limited cytokinin activity. Benzimadazole and adenine are similar in structure and both lack the substituent groups at position 6 found in other cytokinins.

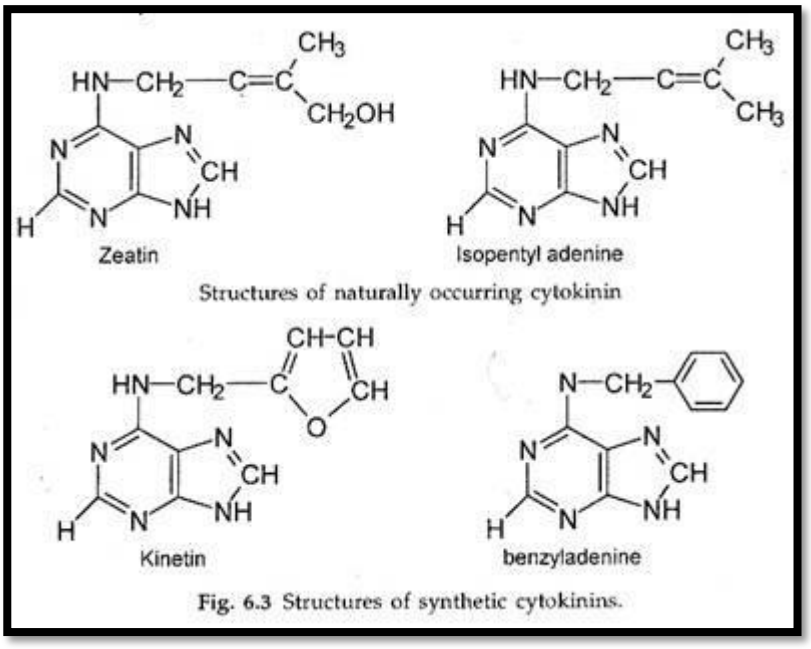

Fig. 6.3 Structures of synthetic cytokinins.

Physiological Effect of Cytokinins:

1. Cell Division

One of the important biological effects of kinetin on plants is to induce cell division in the presence of sufficient amount of auxin (IAA). Skoog and colleagues found that in very low

Dr. Suranjana Sarkar, SNC

concentrations, cytokinins induce callus formation in isolated cells of the pith of tobacco. In combination with auxin, they induce root or shoot meristem.

The cytokinins not only induce cell-division but also help in the continuance of cell- division. A low ratio of cytokinin to auxin induces root development but a high ratio causes buds and shoot also to develop. Under some conditions cytokinins enhance the expansion of cells in leaf disks and cotyledons.

2. Cell enlargement

- Like auxins and gibberellins, the kinetin may also induce cell enlargement.
- Significant Cell enlargement has been observed in kinetin treatment in leaf discs cut from etiolated leaves of *Phaseolus vulgaris*, pumpkin cotyledons, tobacco pith cultures, cortical cells of tobacco roots excised Jerusalem artichoke tissue etc.,

3.Initiation of inter-fascicular cambium

- Kinetin can induce formation of inter - fascicular cambium. This has in fact been shown by Sorokin *et al.* (1962) in pea stem sections.

4. Morphogenesis

- Kinetin also has ability to cause morphogenetic changes in an otherwise undifferentiated callus.
- For instance, the tobacco pith callus can be made to develop either buds or roots by changing the concentration of kinetin and auxin.

5. Counteraction of apical dominance

- Cytokinins play a role in initiating the growth of lateral buds has also been proved by physiological studies made on cytokinin overproducing mutants of tobacco.

6. Dormancy of seeds

- Like gibberellins, the dormancy of certain light sensitive seeds such as lettuce and tobacco can also be broken by kinetin treatment in dark.
- The inhibitory effect of far-red light treatment on the germination of the above seeds is also overcome by kinetin treatment.
- Seeds of parasitic plants e.g., Striga asiatica which require the presence of their host for germination can also be induced to germinate by treating them with kinetin even in the absence of their host.

7. Delay of senescence: The Richmond –Lang Effect

- The ageing process of the leaves usually accompanies with loss of chlorophyll and rapid breakdown of proteins.
- This is called senescence. Richmond and Lang showed that this senescence could be postponed to several days in detached *Xanthium* leaves by kinetin treatment.

Dr. Suranjana Sarkar, SNC

- This effect of kinetin in delaying the senescence is called as Richmond-Lang effect.
- One of the important factors in delay of senescence in kinetin treated leaves is their physiological age.
- Mature leaves of ***Nicotiana rustica*** have been found to be more responsive to kinetin treatment in delaying senescence than the younger leaves.
- The observation of Osborne (1962) and other workers suggest that the high protein content in kinetin treated tissue is probably due to more synthesis of proteins than their degradation, and this in turn may be due to the regulatory action of kinetin on RNA synthesis.

8. Promotion of chloroplast development

- Cytokinins are known to enhance conversion of etioplasts into chloroplast when etiolated seedlings after treatment with cytokinins are exposed to light.
- In such cases, the chloroplasts develop extensive grana and chlorophylls and the rate of synthesis of photosynthetic enzymes is much greater in comparison to those etiolated seedlings which are illuminated without cytokinin treatment.

9. Cytokinins play a significant part in the mobilization phenomena of plants.

Dr. Suranjana Sarkar, SNC